



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 6, June 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Sustainable concrete by Partial Replacement of Cement with Corn COB Powder

Athul Sanil¹, Melwyn Lenoyd Dsouza², Sumanth³, Ranjan S⁴, Sagar S⁵

U.G. Student, Department of Civil Engineering, MITE, Moodbidri, Mangalore, India^{1,2,3,4}

Senior Assistant Professor, Department of Civil Engineering, MITE, Moodbidri, Mangalore, India⁵

ABSTRACT: The high demand for natural resources due to rapid urbanization and the problem of agricultural waste disposal in developed countries have created opportunities for the construction industry to use agricultural waste. This current work focuses on the use of corn cob powder in the production of concrete as a partial alternative to cement. Concrete is the most important and widely used material in the construction industry. This task examines the properties of ready-mixed concrete and hardened concrete and their durability when mixed with agricultural waste. Concrete is mainly a mixture of cement, sand, coarse aggregate, and water in a mixing ratio. With the utilization of this waste as supplementary and replacement materials, there is considerable energy conservation and reduction in the consumption of cement which aids in the reduction of the release of carbon dioxide in the environment. The partial replacement of cement with Corn cob powder by varying percentages are 0%, 2%, 4%, 6%, 8%, and 10% to study the behaviors of fresh properties and hardened properties of replaced Corn cob powder concrete, in comparison with normal conventional concrete.

KEYWORDS: Corn cob powder, Compressive strength, Split tensile strength

I. INTRODUCTION

Concrete is the most versatile and heterogeneous building material and the strongest driver of infrastructure development in all countries. Civil engineering practices and civil engineering work around the world rely heavily on concrete. Concrete is a synthetic building material made by mixing cement, fine aggregate, coarse aggregate, and water in an appropriate ratio. Due to population growth, urbanization, and lifestyle improvements through technological innovation, the construction industry is claiming a variety of natural resources, resulting in a shortage of resources. This rarity motivates the use of solid waste generated by household and agricultural activities the production of one ton of cement discharges one ton of carbon dioxide into the atmosphere. Therefore, the consumption and rate of cement need to economize. Besides it, the disposal of agro-waste from the industries is creating an environmental problem. The sustainable solution is to use agro-waste as a supplementary cementitious material like Corn Cob powder. It helps in cost reduction of concrete that arises due to rising the cost of cement and volume of agro-waste for disposal. The utilization of corn cob powder brings ecological as well as economical benefits to the world. Improved concrete technology can reduce the overload of natural resources and reduce the occurrence of pollution due to the use of additional cement-based materials.

It is necessary to save on the use of cement because we are unable to produce more and more due to the significant contribution to environmental pollution, The excessive value of portland cement, and the excessive intake of herb sources which includes limestone. Significant power and value financial savings may be done while business and agricultural by-products are used as partial replacements for power-in-depth portland cement. It is likewise acknowledged that the presence of mineral admixtures from agricultural residues confers a vast development within the workability and sturdiness of concrete. The use of industrial and agricultural by-products in cement manufacturing is an environmentally friendly way to dispose of large amounts of substances that would otherwise pollute land, water, and air. One of the practical solutions to save cement is to replace cement with industrial by-products and agricultural wastes as supplementary cementitious materials. Pozzolan waste that is being investigated for use in mixed cement includes fly ash, silica fume, volcanic ash, rice hull ash, and corn cob ash. Corn cobs are agricultural waste derived from corn. The most important grain in sub-Saharan Africa.



II. LITERATURE REVIEW

Jing He, Satoru Kawasaki, Varenyam Achal (Aug,2020)

Incorporating these residues into a cementum mass indicates that the addition of waste is not the highest quality environment, but in addition, it provides near-excellent overall performance of concrete properties.

Olukotun Adebisi, Audu Mohammed Taiwo (Nov,2019)

CCA concrete is less strong than controls, such as bulk concrete, screed, and mortar, so it can be used for a variety of concrete work with fewer strength issues. The strength of concrete increases with age after hardening and decreases as the replacement rate of CCA increases

Pranav H Desai (Jun2018)

The CCA can be used to replace 10% of the concrete in concrete production because this alternative reduces the strength of the concrete beyond the control.

Jnyanendra Kumar Prusty, Sanjaya Kumar Patro, S.S. Basarkar (Jun,2016)

This paper outlines some agricultural waste used as a partial replacement for concrete fine aggregate. Agricultural waste concrete, including bagasse ash, sawdust ash, and oyster shells, achieved the required strength with a 20% replacement for fine aggregate

III. OBJECTIVES

- Investigation of fresh properties of conventional and corn cob powder concrete.
- Investigation of compressive strength of concrete made from conventional concrete and corn cob powder.
- Investigation of split tensile strength of conventional concrete and corn cob powder
- By adding the varying percentages of corn cob powder into concrete as a replacement for cement with percentages of 0%, 4%, 6%, 8%, and 10% to study the suitability of corn cob powder as a partial replacement to concrete.

IV. METHODOLOGY

- Literature collection and study
- Material collection and study
- Test on Material study and properties
- Mix Design M-25 Grade of concrete
- Testing of fresh concrete
- Casting of specimens
- Curing of specimens
- Testing mechanical properties of concrete
- Result and Discussions
- Conclusion

V. MATERIALS

Cement

A specific gravity test was conducted using JK brand ordinary Portland cement (OPC) grade 43. All values in the test were compared to the tolerance limits of IS Code 10262: 2009. The specific density of cement is 2.73.

Coarse Aggregate

As consistent with IS code 20mm and 40mm are used. The form of coarse combination in angular, Fineness modulus is 6.23. The precise gravity of the combination is 2.67. The water absorption ratio is 2.06.

Fine aggregate

As per IS codal fine aggregate properties were tested. The fineness modulus is 2.39. The specific gravity of fine aggregate is 2.53. The water absorption ratio is 1.47.

Corn cob powder

Corn cobs were collected from the fields of nearby villages in Belgaum. The corn was removed and the cobs were broken into small pieces to dry in the sun for one week. The dried corn was powdered. The powder was sieved through 90micron.

VI. MIX DESIGN

Concrete Mix proportion

The mixes had been specific with the aid of using IS 10262-2009 blend layout method. Based on the results, the combination turned proportions M25 grade became designed. A concrete blend with an h w/c ratio of 0.46 became prepared. The details of mix proportions for 1m³ of concrete are 1: 2.21: 2.75 (Cement: Fine Aggregates: Coarse Aggregates) with a 0.45 w/c ratio was obtained. Cement 369.75kg, Fine aggregates 920.20kg, Coarse aggregates 1071.32, kg, and water 147.5

Corn cob concrete: Corn cob concrete was prepared by partial replacement of cement with Corn Cob powder at 0%, 2%, 4%, 6%, 8%, 10%, 12% Corn Cob powder replacement level respectively. Six cubes and cylinders of size (Cube: 150mm x 150mm x 150mm, Cylinder:) each mix CCP-0%, CCP-2%, CCP-4%, CCP-6%, CCP-8%, CCP-10%, CCP-12% were casted respectively and cured for 7 and 28 days. After curing time, the cube was crushed to compressive strength and the tensile tester was split to measure the compressive strength of the cube and the split tensile strength of the cylinder.

VII. EXPERIMENTAL INVESTIGATION

Tests On Fresh Concrete

SLUMP CONE TEST

The concrete slump test is used to determine the workability or consistency of concrete mixtures produced in the laboratory or on-site during construction. Concrete hardening tests are performed batch by batch to ensure consistent concrete quality.



Fig 1: Experimental Conducted on Slump Test

Test On Harden Concrete

COMPRESSION STRENGTH

The maximum critical concrete takes a look at it as it gives statistics on all the material's characteristics. This one test can tell you if the concreting was done correctly or not. The water-cement ratio, cement strength, concrete material quality, and quality control throughout the manufacturing process are all factors that influence the compressive strength of concrete.



SPLIT TENSILE STRENGTH

Tensile power is one of the maximum simple and vital traits of concrete. A method for assessing concrete tensile power is the splitting tensile power check on a concrete cylinder. Concrete is extraordinarily susceptible to anxiety because of its brittle nature, and it isn't always predicted to withstand direct anxiety. Cracks shape whilst tensile forces are carried out to the concrete. As a result, the tensile power of the concrete need to be evaluated to decide the most load that the concrete individuals can face up to earlier than cracking.

VIII. EXPERIMENTAL RESULT

SLUMP TEST

SL.N O	% Of Corn cob powder Replacement	W/C Ratio	Slump in mm
1.	0%	0.46	80
2.	2%	0.46	68
3.	4%	0.46	65
4.	6%	0.46	63
5.	8%	0.46	61
6.	10%	0.46	60

Table 1:

Slump Value for Percentage of Corn Cob Powder Replacement

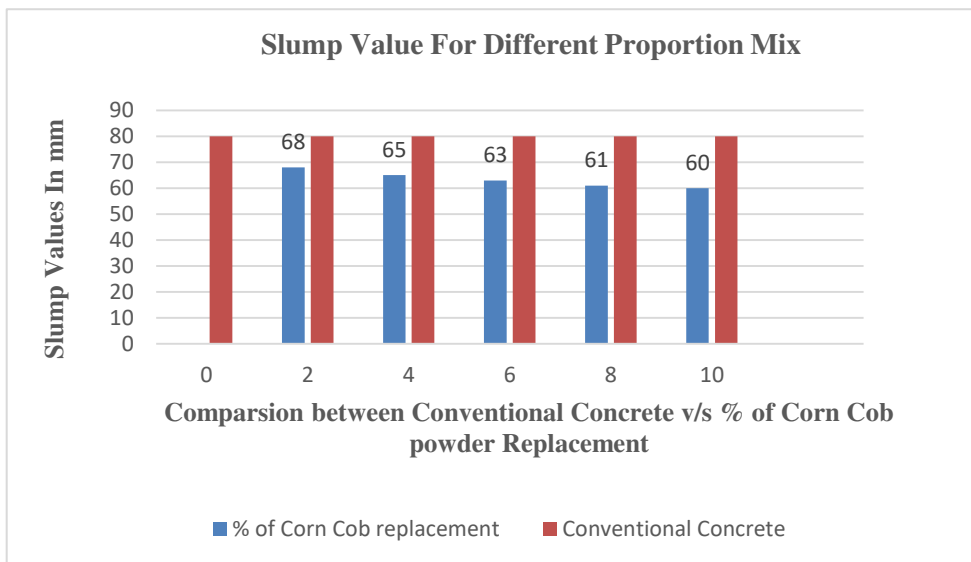


Fig 2: Slump Value for Different Proportion Mix



COMPRESSIVESTRENGTH(IS516:2021)

SL.NO	% Of Corn Cob powder Replacement	AveragecompressionstrengthInMpa	
		7 Days	28Days
1.	0	18.6	31.00
2.	2	17.4	29.00
3.	4	16.5	27.50
4.	6	15.21	25.35
5.	8	13.9	23.00
6.	10	13.11	21.85

Table 2: CompressiveStrengthofPercentage ofCorn cob powderReplacement

SL.NO	AverageCompressionStrengthInMpa	
	7 Days	28Days
1.	26.20	33

Table 3: CompressiveStrengthofConventionalConcrete

Compressive strength at 7 days

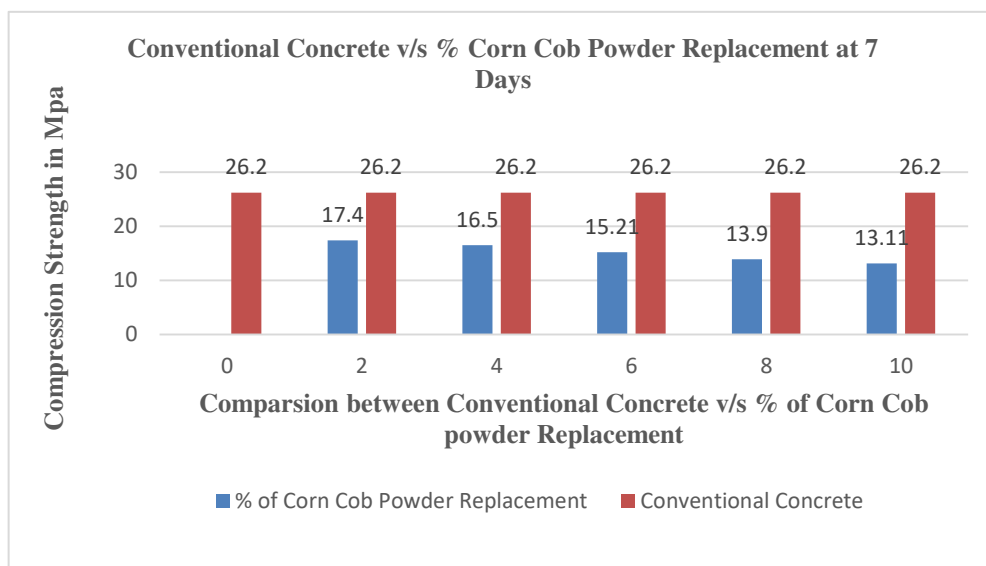


Fig 3: Conventional Concrete v/s % Corn Cob Powder Replacement at 7 Days



The graph shows that when 6% of the cement is replaced with corn cob powder, the compressive strength is highest and the hydration process is highest at a young age. It is also lowered to achieve a better percentage exchange rate.

Compressive strength at 28 days

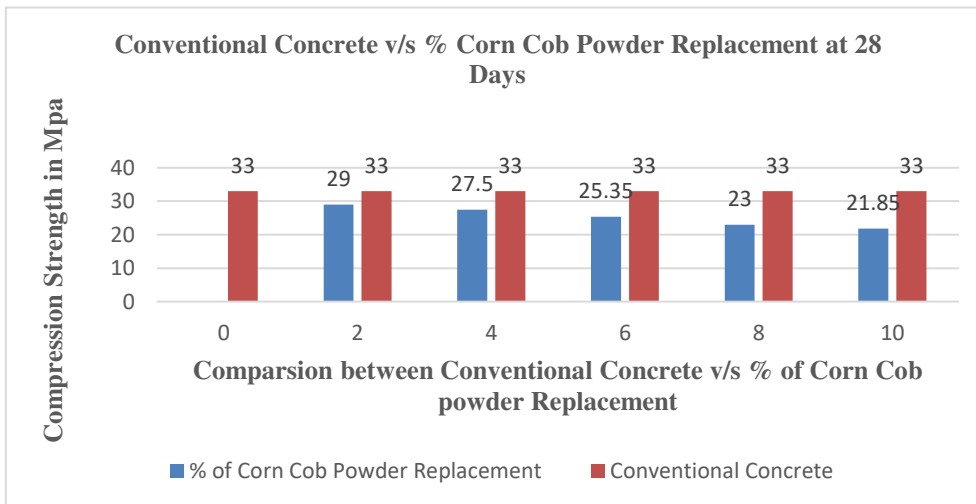


Fig 4: Conventional Concrete v/s % Corn Cob Powder Replacement at 28 Days

According to the graph, the compressive power is maximum whilst 6% of the cement is changed with Corn Cob powder, implying that the hydration method is at its height early. It is likewise reduced to acquire a better % substitute rate.

SPLIT TENSILE STRENGTH (IS 5816:2004)

SLNo.	% Of Corn cob powder Replacement	Tensile Strength (Mpa)	
		7 days	28 days
1	0	1.86	3.1
2	2	1.74	2.9
3	4	1.65	2.7
4	6	1.52	2.53
5	8	1.39	2.30
6	10	1.31	2.18



Table 4: Split Tensile Strength % of Corn Cob Powder Replacement

SL.NO	Tensile Strength in Mpa	
	7 Days	28 Days
1.	1.56	2.83

Table 5: Split Tensile Strength of Conventional Concrete

Tensile strength at 7 days

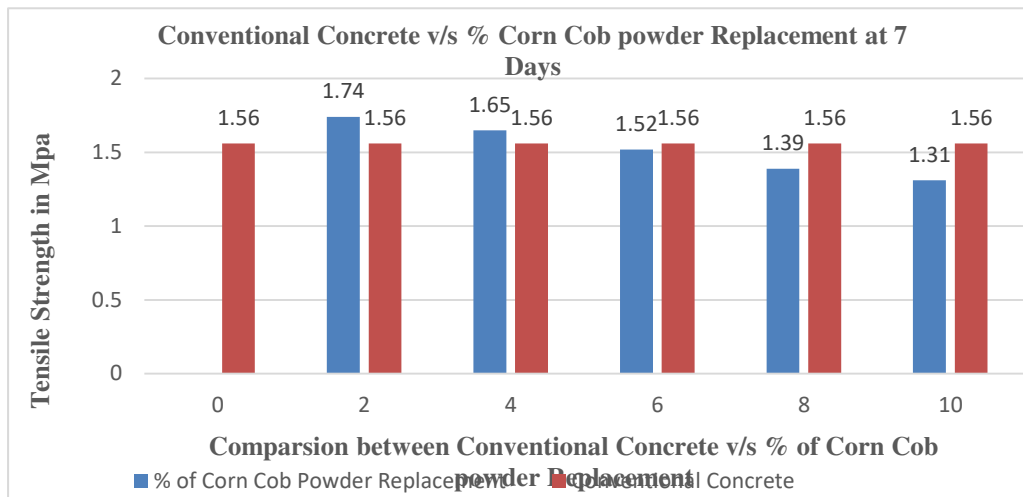


Fig 5: Conventional Concrete v/s % Corn Cob powder Replacement at 7 Days

The information suggests that the Split Tensile energy is maximum whilst 6% of the cement is changed with Corn Cob powder, implying that the hydration technique is at its height early. It is likewise decreased to acquire a better % substitute rate.

Tensile strength at 28 days

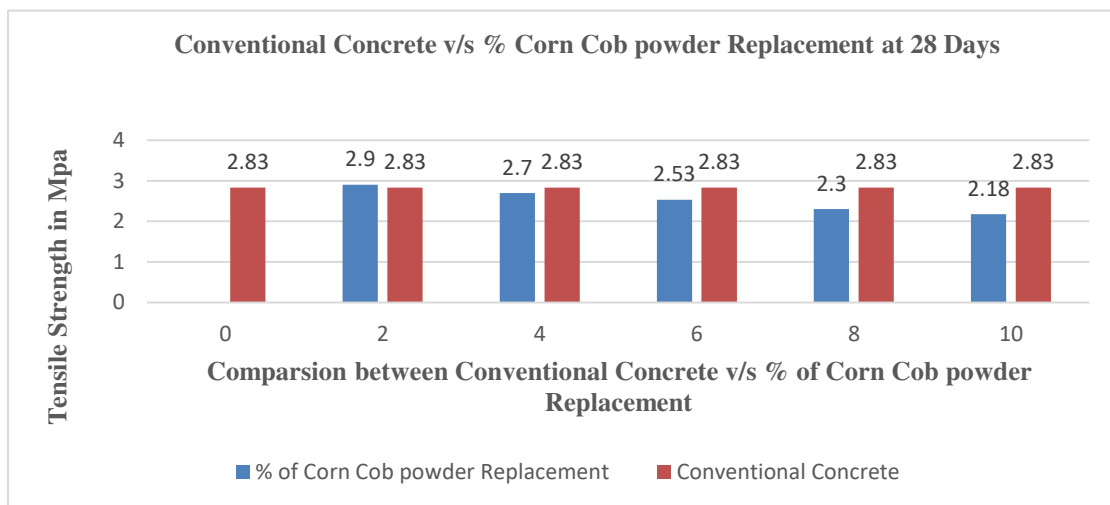


Fig 6: Conventional Concrete v/s % Corn Cob powder Replacement at 28 Days



From the graph the Split Tensile strength is highest when 6% of the cement is replaced with Corn Cob powder, implying that the hydration process is at its peak early. It's also reduced for a higher percentage replacement rate.

IX. CONCLUSION

The influence of the amount of Corn Cob powder on the characteristics of concrete is investigated in this study. The gathered data can be used to the following conclusions:

- Maximum Compression Strength is obtained for 6% of cement can be replaced by Corn Cob powder without change in the strength of the concrete. Above 6% replacement of corn cob powder will decrease the strength of the concrete.
- Maximum split tensile strength can be reached by 6% replacement of cement with Corn Cob powder. Above 6% replacement of corn cob powder will decrease the strength of the concrete.
- By reducing Portland cement output and CO₂ emissions, the use of limestone powder in cement and concrete delivers economic and environmental benefits.
- Basic test on Cement, Corn Cob Powder, Coarse Aggregates, Water, and limits as per the IS Code provisional

REFERENCES

- [1] Irfan Ali Shar, Dr. Fareed Ahmed Memon, "Use of Wheat Straw Ash as Cement Replacement Material in the Concrete" July 1975.
- [2] D.A. Adesanya, A.A. Raheem, "A study of the workability and compressive strength characteristics of corn cob ash blended cement concrete", Vol 23, Jan 2009
- [3] Ajay Goyal, Monika Garg, "Synergic Effect of Wheat Straw Ash and Rice-Husk Ash on Strength Properties of Mortar", Vol 7, Aug 2007
- [4] Samiullah Sohu, Ashok Kumar, "Effect of Wheat Straw Ash on Fresh and Hardened Concrete Reinforced with Jute Fiber", Jan 2021
- [5] Ahangba Augustine. S, Tiza Michael, "Partial Replacement of Cement with Corn Cob Ash", Volume - 2, Issue - 7, July - 2016
- [6] Sunita Kumari, Dinesh Chander, Rinku Walia, "Durability and Strength analysis of Concrete by Partial Replacement of Cement with Corn Cob Ash and Rice Husk Ash", Vol.6, No.7, July 2018
- [7] Pranav H Desai, "Experimental Study on Corn Cob Ash Powder as Partial Replacement of Cement In Concrete", Volume: 05 Issue: 06 (June-2018)
- [8] Adesanya, D. A., and Raheem, A. A. (2009a), "A study of the workability and compressive strength characteristics of corn cob ash blended cement concrete", Construction and Building Materials, Vol. 23, pp. 311–317.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.118



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details